What we know;

Standard Form - $y = ax^2 + bx + c$
Factored Form - $y = a(x - s)(x - r)$
Vertex Form - $y = a(x - h)^2 + k$

Students will learn;

How to convert FROM **Standard** form to **VERTEX** form

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(6.3) Completing the Square

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*** Moving from **STANDARD** form TO **VERTEX** form

$ax^2 + bx + c = 0$

Examine each of these perfect squares:

$x^2 + 4x + 4$ $x^2 - 14x + 49$ $x^2 + 6x + 9$

If you know these are perfect squares, what rule can you state that will determine *c* if you know *b*?

_____

_____

Practice: What constant must you add to the expressions to create a perfect square?

a) $x^2 + 20x$ _____ b) $y^2 - 2y$ _____ c) $a^2 + 100a$ _____

When we complete the square we **create a perfect square trinomial** and factor it to get $(x - h)^2$

Steps to complete the square

(6.3) Completing the Square

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*** Moving from **STANDARD** form TO **VERTEX** form

$ax^2 + bx + c = 0$

Examine each of these perfect squares:

$\sqrt{x^2} + 4x + \sqrt{4}$ $\sqrt{x^2} - 14x + \sqrt{49}$ $\sqrt{x^2} + 6x + \sqrt{9}$

If you know these are perfect squares, what rule can you state that will determine *c* if you know *b*?

$x \quad 2 \times 2 = 4x$ $x \quad 7 \times 2$ $x \quad 3 \times 2$

$(x+2)^2$ $(x-7)^2$ $(x+3)^2$

Practice: What constant must you add to the expressions to create a perfect square?

a) $x^2 + 20x$ $+100$ b) $y^2 - 2y$ $+1$ c) $a^2 + 100a$ $+2500$

$x \quad 10$ $y \quad 1$ $a \quad 50$

When we complete the square we **create a perfect square trinomial** and factor it to get $(x - h)^2$

$(x+10)^2$ $(y-1)^2$ $(a+50)^2$

Steps to complete the square

Technique for "Completing the Square"

Example: $y = 2x^2 + 4 + 12x$

Step 1: Verify that the relation is in standard form.

$y = 2x^2 + 12x + 4$

Step 2: Factor the **coefficient** of the x^2 term from the first two terms ONLY.

$y = 2(x^2 + 6x) + 4$

$\left(\frac{b}{2}\right)^2 = \left(\frac{6}{2}\right)^2 = 3^2 = 9$

Step 3: Create a perfect square in the bracket. Add **and** subtract $\left(\frac{b}{2}\right)^2$

$y = 2(x^2 + 6x + 9 - 9) + 4$

$y = 2[(x+3)^2 - 9] + 4$

Step 4: Remove $-\left(\frac{b}{2}\right)^2$ from bracket by multiplying it by *a* and placing the result outside brackets.

$y = 2(x+3)^2 - 18 + 4$

Step 5: Factor the perfect square trinomial you created in the bracket and collect the like terms outside the bracket.

$y = 2(x+3)^2 - 14$

$y = a(x-h)^2 + k$

$(-3, -14)$

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Put in Vertex Form

$y = x^2 - 4x + 17$ $\left(\frac{b}{2}\right)^2$

$y = x^2 - 4x + 4 - 4 + 17$ $\left(\frac{4}{2}\right)^2$

$y = (x-2)^2 - 4 + 17$ $(2)^2$

$y = (x-2)^2 + 13$ 4

(h, k)

$(2, 13)$

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$y = x^2 - 6x + 25$

$(x)(-3)(2) = 10$

$y = x^2 - 6x + 9 - 9 + 25$ $\left(\frac{6}{2}\right)^2$ 3^2 9

$y = (x-3)^2 - 9 + 25$

$y = (x-3)^2 + 16$

$(3, 16)$

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Example 2: Complete the square of $y = x^2 + 8x - 15$

$y = x^2 + 8x + 16 - 16 - 15$

$\left(\frac{8}{2}\right)^2$ $y = (x + 4)^2 - 16 - 15$

$(4)^2$ $y = (x+4)^2 - 31$

16 $y = a(x-h)^2 + k$

$(-4, -31)$

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Example 1: Express $y = 3x^2 + 6x - 2$ in vertex form.

$y = 3(x^2 + 2x) - 2$

$\left(\frac{2}{2}\right)^2$ $y = 3(x^2 + 2x + 1 - 1) - 2$

$(1)^2$ 1 $y = 3[(x + 1)^2 - 1] - 2$

$y = 3(x+1)^2 - 3 - 2$

$y = 3(x+1)^2 - 5$

h k

$(-1, -5)$

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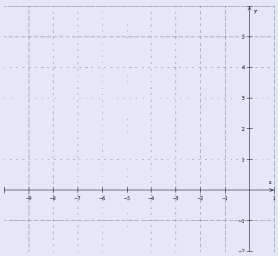
Example 3: If $y = -2x^2 - 20x - 47$

a) Complete the square to express the relation in vertex form.



b) Graph the relation.

i) vertex:
ii) direction of opening:
iii) axis of symmetry:
iv) optimum value:
v) maximum or minimum:
vi) y-intercept:
vii) shape:

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Example 3: If $y = -2x^2 - 20x - 47$

a) Complete the square to express the relation in vertex form.

$y = -2(x^2 + 10x) - 47$ $\left(\frac{10}{2}\right)^2 = 25$

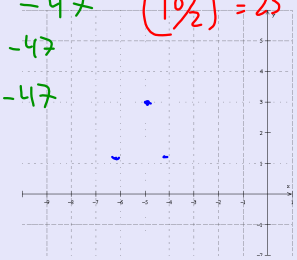
$y = -2(x^2 + 10x + 25 - 25) - 47$

$y = -2[(x + 5)^2 - 25] - 47$

$y = -2(x+5)^2 + 50 - 47$

$y = -2(x+5)^2 + 3$

$(-5, +3)$



b) Graph the relation.

i) vertex:
ii) direction of opening:
iii) axis of symmetry:
iv) optimum value:
v) maximum or minimum:
vi) y-intercept:
vii) shape:

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Homework

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Note

$y = x^2 + 5x + c$

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